Appendix E-2

"HAP Benefits Analysis in Section 812 Reports to Congress; Briefing for SAB/EPA Workshop, June 22, 2000,"

Presented by Mr. James DeMocker

HAP Benefits Analysis in §812 Reports to Congress

Briefing for SAB/EPA Workshop

June 22, 2000

Jim DeMocker, EPA/OAR

§812 Benefit-Cost Analyses
Analytical Requirements

- "(a)...The Administrator shall conduct a comprehensive analysis of this Act on the public health, economy, and environment… [which] should consider the costs, benefits and other effects...[of] each standard issued for… (2) a hazardous air pollutant listed under §112, including any technology-based standard and any risk-based standard…"

- "(b)…The Administrator shall assess how benefits are measured in order to assure that damage to human health and the environment is more accurately measured and taken into account."

§812 Benefit-Cost Analyses
Review Requirements

- "(f)...The Administrator shall appoint an Advisory Council… [consisting of] recognized experts in… health and environmental effects of air pollution, economic analysis, environmental sciences, and other [appropriate] fields."

- "(g)…The Council shall review… the data… the methodology… and the findings of such report, and make recommendations to the Administrator concerning the validity and utility of such findings."

§812 Benefit & Cost Estimation

- "Retrospective Study"
  - Submitted to Congress October 1997
  - Direct costs aggregated and fed to macro model
  - Benefits by pollutant as data and models allowed
- "Prospective Study"
  - Submitted to Congress November 1999
  - Direct costs estimated by title / major provision
  - Benefits by pollutant as data and models allowed

Retrospective Study
Stationary Source Pollutants
14 key HAPs from Cancer Risk Study (1990):

- arsenic
- asbestos
- benzene
- 1,3-butadiene
- carbon tetrachloride
- chloroform
- chromium (VI)
- dioxin
- ethylene dichloride
- ethylene dibromide
- formaldehyde
- gasoline vapors
- product of incomplete combustion (PICs)
- vinyl chloride

Retrospective Study
Stationary Source Method

- Incidence change assumed proportional to emissions change

$$I_{ty} = I_{by} \times \frac{A_{ty}}{A_{by}} \times \frac{P_{ty}}{P_{by}} \times \frac{(1 - C_{ty})}{(1 - C_{by})}$$

I = incidence (from CRS)

A = activity (from macro model)

P = population

C = control efficiency (from CTGs, BIDs, regs, experts)

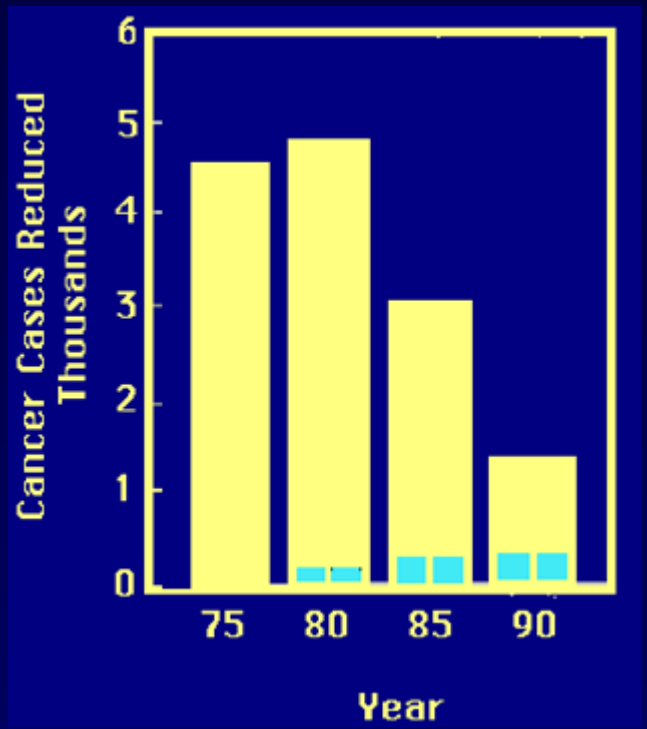
by = base year (85)

ty = target year (70, 75, 80, 90)

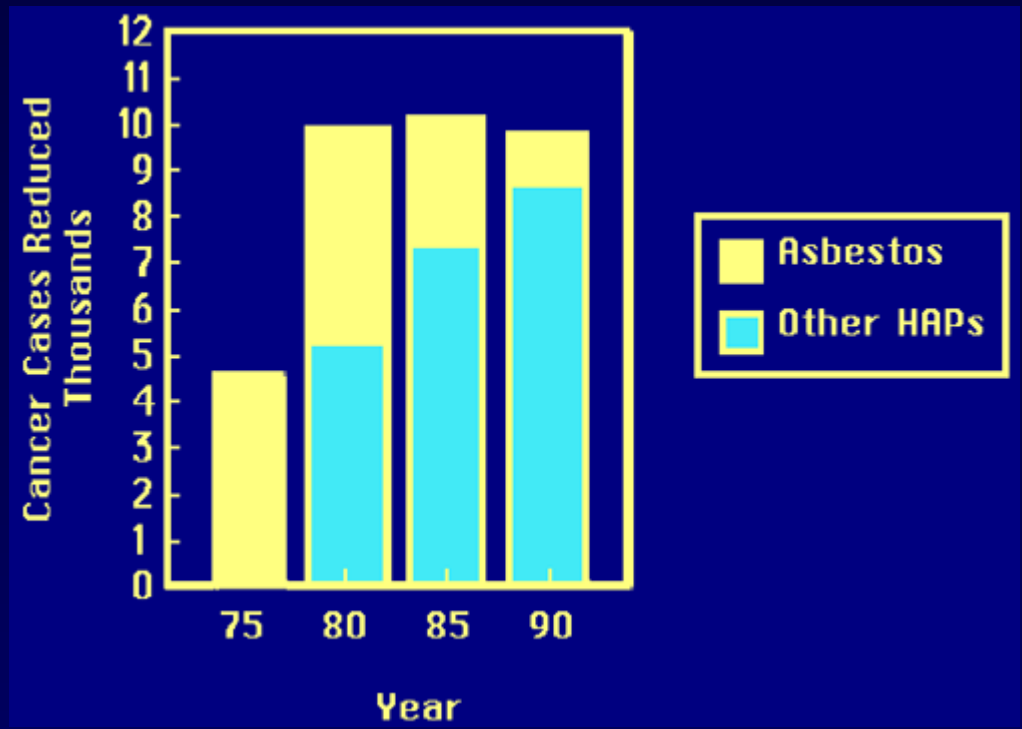
Retrospective Study

Stationary Source Findings

Lower Bound for Other HAPs



Upper Bound for Other HAPs



Retrospective Study
Stationary Source Review Issues

- Estimated incidence for vinyl chloride and asbestos much higher than historical incidence
- Cancer Risk Study designed for only rough order-of-magnitude estimates
  - Unit risk factors are upper-bound estimates
  - Exposure estimates are typically upper-bound (MEI)
- Control efficiencies assumed uniform across facilities and 100% compliance with regulations

Retrospective Study
Report to Congress Presentation

- HAP benefits excluded from primary analysis - described in Appendix
- Quantitative analyses with caveats
  - Stationary source cancer incidence reduction estimates
  - Motor vehicle exposure reduction estimates
- Qualitative discussions
  - non-cancer health effects
  - ecosystem effects

Retrospective Study

Report to Congress

-- Health Research Recommendations --

- Address additional pollutants
- Address mechanisms with pharmacokinetics
- Address variations in human susceptibility
- Address interactive effects of multiple exposures
- Develop alternatives to cancer upper-bound methods
- Develop D/R relationships for non-cancer effects
- Develop methods for acute exposure effects

Retrospective Study

Report to Congress

-- Exposure Research Recommendations --

- Expand data collection: control efficiencies, HAP speciation, facility locations and operating parameters
- Develop more comprehensive exposure models
- Refine uncertainty analysis methods

Retrospective Study

Report to Congress

-- Ecosystem Research Recommendations --

- Estimate levels of bioaccumulating toxics in media
- Correlate levels of bioaccumulating toxics with exposures, concentrations, and adverse effects
- Develop wildlife correlate to RfD or D/R relationship
- Address effects of mixtures
- Address additional ecosystems
- Address wetland species and functions

Retrospective Study
Report to Congress
-- Valuation Research Recommendations --

- Address additional endpoints consistent with kinds of damages expected

- Initiate broad-scope economic valuation using survey techniques

Prospective Study
Methodology Alternatives Presented
-- National Scale --

- Assessment System for Population Exposure Nationwide (ASPEN)
  - Emissions inventory
    - multiple pollutants
  - Air dispersion model
    - point, area, and mobile source categories
  - Exposure model (not completed)

Prospective Study
Methodology Alternatives Presented
-- National Scale --

- Advantages
  - Includes treatment of
    - reactive decay (simplified)
    - secondary formation (simplified)
    - long-range transport (continental scale)
    - wet and dry deposition (parameterized)
  - Emissions/Dispersion well documented:
    - sensitivity analysis
    - model performance evaluation
    - uncertainty analyses

Prospective Study
Methodology Alternatives Presented
-- National Scale --

- Limitations
  - National emission inventory uncertainties
  - Gaussian model limitations
  - Meso-scale transport not addressed (50 - 200 km)
  - Re-suspension not addressed
  - Not stochastic
  - Spatial and temporal peaks not addressed
  - Indoor sources not addressed
  - Indirect exposures not addressed

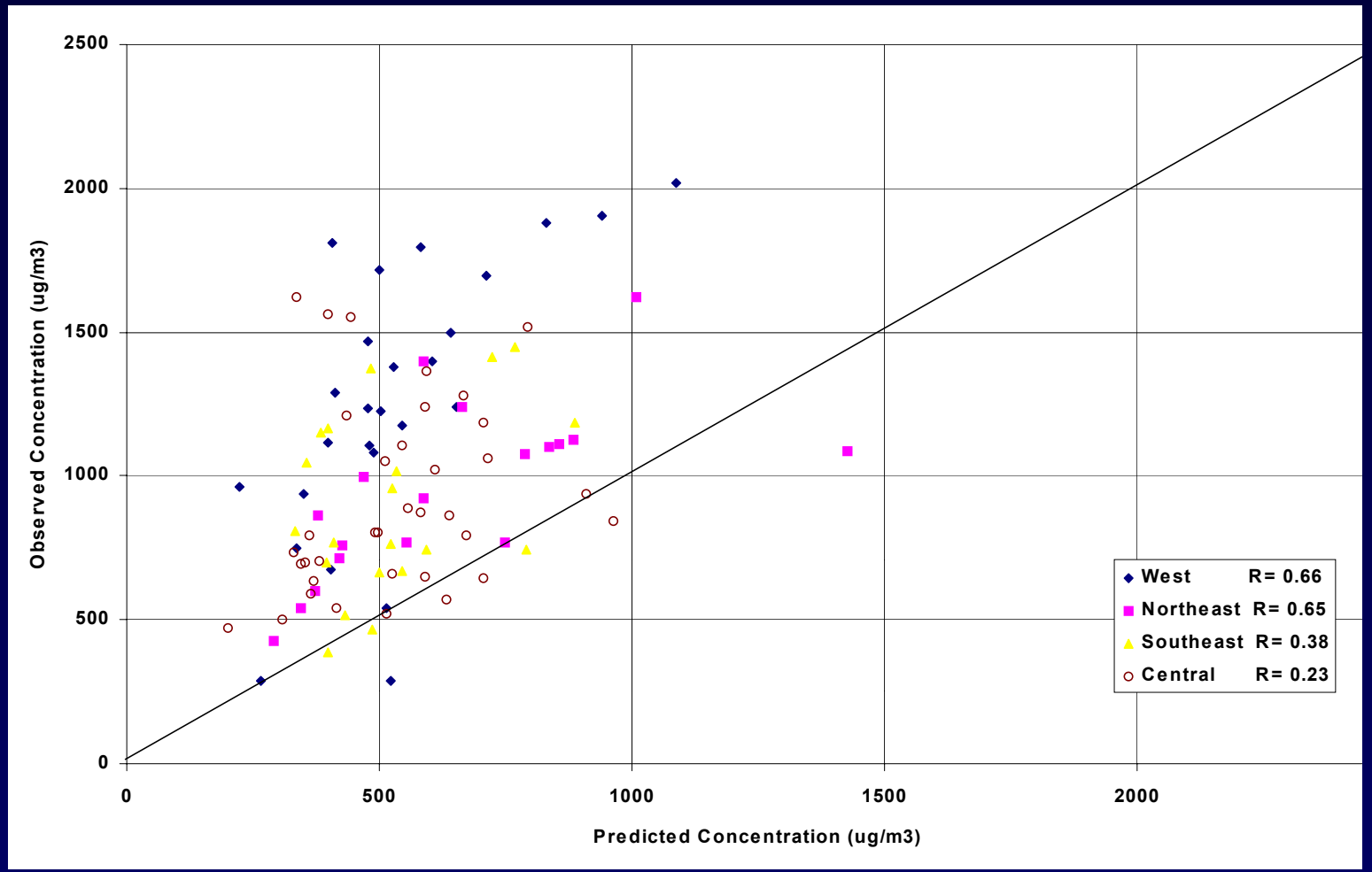
Prospective Study
Methodology Alternatives Presented
-- Local Scale / Case Study --

- Air Quality Integrated Management System (AIMS)
- Developed for Baltimore and planned for Houston and Chicago
- Integrates routinely collected data (measured air quality, emissions, and meteorological data) and dispersion modeling

Prospective Study
Review Issues Raised

- Resources for in-depth analysis for 188 HAPs prohibitive: find priority HAPs
- Unit Risk Factors are upper-bound estimates
- Limited ambient monitoring data to validate ambient concentration estimates
- Exposure assessment limitations
  - 50 km downwind distance for dispersion
  - lack of attention to indirect pathways (e.g., Hg, dioxin)
  - ASPEN preliminary performance evaluation concerns

ASPEN Model Performance
1990 Carbon Monoxide



Prospective Study:
Report to Congress Presentation

- No quantified benefits
- Expect benefits from MACT and incidental to criteria pollutant control
- Besides cancer inhalation impacts, other potential benefits include reductions in:
  - Non-cancer health effects
  - Indirect non-inhalation exposure
  - Ecological and welfare effects

Prospective Study
Report to Congress Research Recommendations

- Workshops to address HAP benefits challenges:
  - toxicology/risk assessment
  - exposure assessment
  - economics
- Investigate use of EPA's Air Toxics Data Archive of measurement data from state / local programs
- Explore whether "supersite" monitoring programs can provide HAP ambient concentration data

Future §812 Studies

- Pondering potential scope, objectives, and reference period for “812 III”
- Detailed analytic blueprint to be developed, and HAP Workshop outcomes will be considered
- SAB Council and HEES will be asked to review analytical blueprint prior to initiation of work

Backup slides

Retrospective Study:
Mobile Source Analysis
-- Methods --

- Based on Motor Vehicle Related Air Toxics Study (1993)
- Exposure estimated for CO using measured concentrations and HAPEM-MS
- Exposure to HAPs assumed proportional to emission factors

Retrospective Study:

Mobile Source Analysis

-- Methods and Data--

$$E = ((A \times C) - B) \times M \times S \times \frac{VOC \times HAP}{CO}$$

E = exposure concentration

A = annual average CO ambient concentration (AIRS)

C = CO ambient to CO exposure concentration ratio (HAPEM)

B = CO background concentration (reported measurements)

M = fraction of CO emissions from mobile sources

S = scenario-to-control scenario CO emission factor ratio

VOC = VOC mobile emission factor by, scenario/year

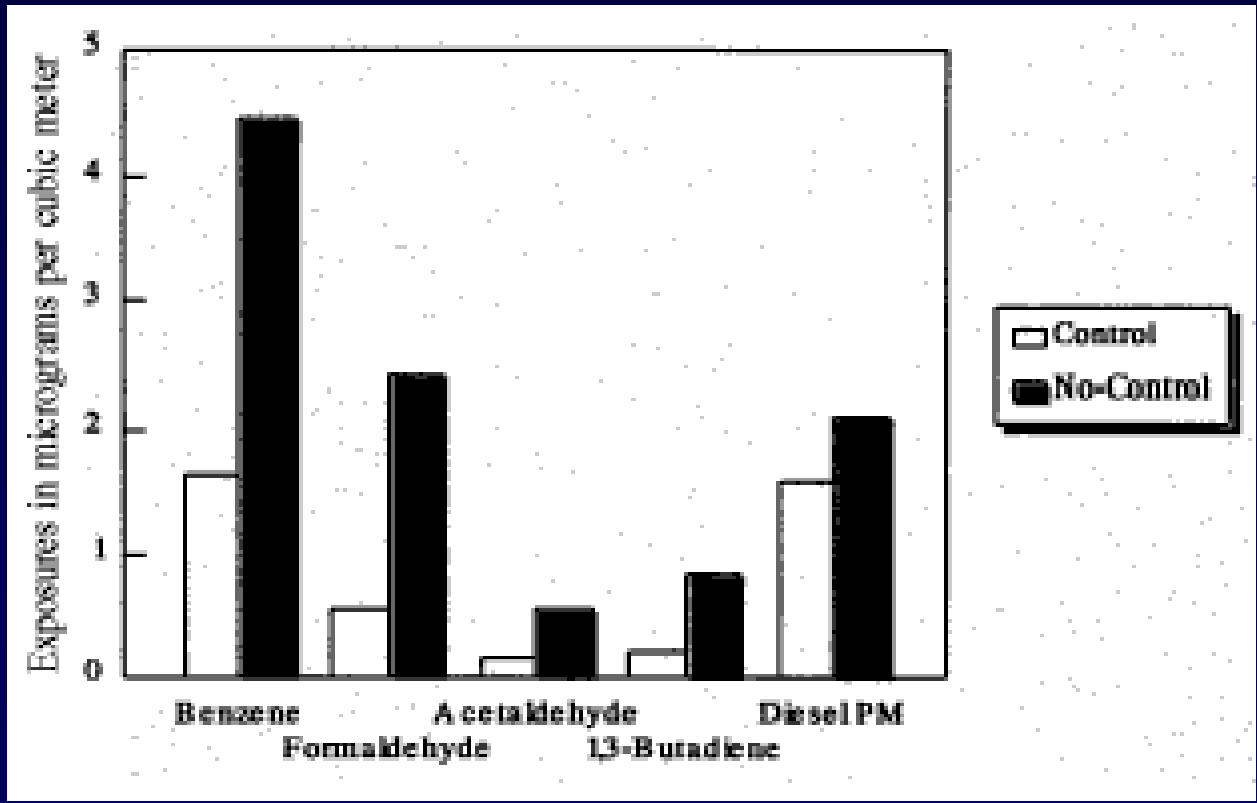
HAP = HAP speciation factor for mobile source VOC, by scenario/year

CO = mobile source emission factor, by scenario/year

Retrospective Study:

Mobile Source Analysis

-- Findings --



Future 812 Studies
Tools Needed

- Expanded air toxics monitoring data
  - 90 new monitors by end of FY00
  - Air Toxics Data Archive to supplement AIRS with state and local data
- Improved emissions inventories
  - 1996 National Toxics Inventory (NTI)
- Evaluation/enhancement of air quality and exposure modeling tools
- Expanded risk data and improved methods

Future 812 Studies
Risk Assessment Workshop

- Current risk assessment state-of-the-art
  - Probabilistic estimates for cancer
  - Reference doses/concentrations for non-cancer
    - More sophisticated D/R assessments for some criteria pollutants
  - Mixtures
    - Sum of upper-bounds for cancer
    - Hazard index for non-cancer

Future 812 Studies
Risk Assessment Workshop

- Recent trends in risk assessment
  - Cancer: mix of probabilistic (no threshold) and reference concentrations (threshold)
  - Non-cancer: modeling and distributional approaches
  - Dosimetry models focused on tissue concentrations

Future 812 Studies
Risk Assessment Workshop

- Potential sources of bias in risk estimates
  - Linear high-to-low dose extrapolation
  - Cross species scaling factor
  - Treatment of untested chemicals and other data gaps
  - Latent effects
  - Use of most sensitive test results
  - Non-cancer uncertainty factors
  - Magnitude and severity of effects
  - Route-to-route extrapolation
  - Benchmark response rate (LED10 instead of NOAEL)
  - Additive treatment of mixtures

Future 812 Studies
Risk Assessment Workshop

- Uncertainty in risk estimates
  - Types
    - Causal link between exposure and effects
    - Magnitude of risk
  - Can use analysis of quantifiable uncertainty to develop central risk estimate
  - Unquantifiable uncertainty may still lead to bias
    - use of sensitive species
    - consideration of non-relevant effects

Future 812 Studies
Risk Assessment Workshop

- Topics for discussion
  - How to characterize a distribution of risk estimates as an input to benefits assessment
  - How to characterize the value of reducing exposure in a reference dose framework: proportion of people above RfD, contingent valuation, other?
  - How to characterize benefits when uncertainty is great: point estimate, range, other?
  - Are some benefits better left unquantified?